Claims

1. A process of recovering arabinose and optionally at least one other monosaccharide selected from the group consisting of galactose, rhamnose and mannose from vegetable fiber rich in heteropolymeric arabinose, wherein the process comprises the following steps:

(a) controlled acidic or enzymatic hydrolysis of said vegetable fiber in an aqueous solution to hydrolyze more than 50% of the heteropolymeric arabinose present in the vegetable fiber into monomeric arabinose and to produce an aqueous hydrolyzate containing at least 10% arabinose on DS, at least one other monosaccharide selected from the group consisting of galactose and optionally rhamnose and mannose, and optionally poly-, oligo- and/or disaccharides, soluble polymers and undissolved solids,

(b) optional neutralization of said aqueous hydrolyzate to obtain a neutralized hydrolyzate,

(c) separation of undissolved solids from said aqueous hydrolyzate obtained in step (a) or from said neutralized hydrolyzate obtained in step (b) to obtain a clarified hydrolyzate,

(d) optional fractionation of said clarified hydrolyzate in an aqueus solution to obtain a fraction enriched in arabinose, which contains at least 50% arabinose and less than 30% of one or more monosaccharides selected from galactose and optionally rhamnose and mannose on DS, at least one other fraction selected from the group consisting of a fraction enriched in galactose, a fraction enriched in rhamnose and a fraction enriched in mannose, and optionally one or more fractions enriched in poly-, oligo- and/or disaccharides and soluble polymers, followed by the recovery of said fraction enriched in arabinose and optionally one or more of said other fractions, and

(e) crystallization of arabinose in an aqueous solution from said hydrolyzate obtained in step (c) or from said fraction enriched in arabinose obtained in step (d) to obtain crystalline arabinose having a galactose content of less than 1% on DS.

2. A process as claimed in claim 1, wherein said vegetable fiber rich in heteropolymeric arabinose contains more than 15% arabinose on DS.

3. A process as claimed in claim 2, wherein said vegetable fiber contains more than 35% arabinose on DS.

4. A process as claimed in claim 2, wherein said vegetable fiber rich in heteropolymeric arabinose is an exudate gum.

5. A process as claimed in claim 4, wherein said exudate gum is selected from gum arabic, gum ghatti and gum tragacanth.

6. A process as claimed in claim 1, wherein said vegetable fiber rich in heteropolymeric arabinose is sugar beet pulp.

7. A process as claimed in claim 1, wherein said vegetable fiber rich in heteropolymeric arabinose is selected from hardwood bark, grain straw and hulls, corn husks, corn cobs, corn fibers and bagasse.

8. A process as claimed in claim 7, wherein said hardwood bark is selected from beech bark and birch bark.

9. A process as claimed in claim 1, wherein said vegetable fiber rich in heteropolymeric arabinose is water-soluble or alkali soluble vegetable fiber.

10. A process as claimed in claim 1, wherein said controlled hydrolysis of step (a) provides an aqueous hydrolyzate where more than 70% of said heteropolymeric arabinose is hydrolyzed into monomeric arabinose.

11. A process as claimed in claim 10, wherein more than 80% of said heteropolymeric arabinose is hydrolyzed into monomeric arabinose.

12. A process as claimed in claim 1, wherein said controlled hydrolysis of step (a) provides an aqueous hydrolyzate where the content of arabinose is more than 15% on DS.

13. A process as claimed in claim 12, wherein the content of arabinose is more than 20% on DS.

14. A process as claimed in claim 1, wherein said hydrolysis is carried out as a selective hydrolysis by adjusting the hydrolysis conditions so as to obtain a hydrolyzate where the content of galactose is less than 10% on DS.

15. A process as claimed in claim 14, wherein the content of galactose is less than 5% on DS.

16. A process as claimed in claim 15, wherein the content of galactose is less than 2% on DS.

17. A process as claimed in claim 1, wherein said hydrolysis is carried out in the acid concentration of 0.1-5 % and with an acid selected from mineral acids and organic acids.

18. A process as claimed in claim 17, wherein said inorganic acid is sulphuric acid.

19. A process as claimed in claim 17, wherein said hydrolysis is carried out at a temperature in the range of 70 to 140°C, at a pH in the range of 0.7 to 2.5 and the hydrolysis is continued for 0.4 to 6 hours.

20. A process as claimed in claim 1, wherein said fractionation of step (d) is carried out by chromatographic fractionation to obtain a fraction enriched in arabinose, at least one other fraction selected from a fraction enriched in galactose, a fraction enriched in rhamnose and a fraction enriched in mannose, and optionally one or more fractions enriched in poly-, oligo- and/or disaccharides and soluble polymers.

21. A process as claimed in claim 20, wherein said chromatographic fractionation is carried out using a column packing material selected from cation exchange resins.

22. A process as claimed in claim 21, wherein said cation exchange resins are selected from strongly acid cation exchange resins.

23. A process as claimed in claim 22, wherein the ion form of said strongly acid cation exchange resin is selected from H^+, Na^+, K^+, Ca^{2+}, Mg^{2+}, NH_4^+ Al^{3+}, Sr^{3+} and Ba^{2+}.

24. A process as claimed in claim 21, wherein said cation exchange resins are selected from weakly acid cation exchange resins.

25. A process as claimed in claim 24, wherein the ion form of said weakly acid cation exchange resins is selected from H^+, Na^+ and Ca^{2+}.

26. A process as claimed in claim 20, wherein said chromatographic fractionation is carried out using a column packing material selected from anion exchange resins.

27. A process as claimed in claim 26, wherein said anion exchange resins are selected from weakly basic anion exchange resins.

28. A process as claimed in claim 26, wherein said anion exchange resins are selected from strongly basic anion exchange resins.

29. A process as claimed in claim 28, wherein the ion form of said strongly basic anion exchange resin is selected from HSO_3^- and SO_4^{2-}.

30. A process as claimed in claim 1, wherein said fractionation of step (d) is carried out by membrane filtration.

31. A process as claimed in claim 30, wherein said membrane filtration is carried out by nanofiltration to obtain a fraction enriched in arabinose as the nanofiltration permeate and a fraction enriched in poly-, oligo- and/or disaccharides as the nanofiltration retentate.

32. A process as claimed in claim 1, wherein the process comprises at least two fractionations selected from chromatographic fractionation and/or membrane filtration.

33. A process as claimed in claim 1, wherein the arabinose yield in the fraction enriched in arabinose obtained from step (d) is more than 50% of the arabinose present in the hydrolyzate.

34. A process as claimed in claim 1, wherein said fraction enriched in poly-. oligo- and/or disaccharides is further subjected to hydrolysis to obtain a hydrolyzate containing galactose and optionally rhamnose, mannose and additional arabinose.

35. A process as claimed in claim 34, wherein the process further comprises separating galactose and optionally rhamnose, mannose and additional arabinose from said hydrolyzate obtained in step (c).

36. A process as claimed in claim 1, which further comprises the recovery of a fraction enriched in soluble polymers obtained in step (d).

37. A process as claimed in claim 36, wherein the soluble polymers comprise pectin.

38. A process as claimed in claim 1, which further comprises the separation of xylose from said hydrolyzate as a prefractionation step before the fractionation step (d).

39. A process as claimed in claim 1, wherein said crystallization of arabinose in step (e) is carried out from said hydrolyzate obtained in step (c).

40. A process as claimed in claim 1, wherein said crystallization of arabinose in step (e) is carried out from said fraction enriched in arabinose obtained in step (d).

41. A process as claimed in claim 1, wherein said crystallization of arabinose in step (e) comprises boiling crystallization.

42. A process as claimed in claim 41, wherein said boiling crystallization is combined with cooling crystallization.

43. A process as claimed in claim 1, wherein said crystallization of arabinose comprises cooling crystallization.

44. A process as claimed in claim 1, wherein said crystallization of arabinose in step (e) is carried out from a solution having an arabinose purity of more than 60% on DS.

45. A process as claimed in claim 44, wherein the arabinose purity is more than 70% on DS.

46. A process as claimed in claim 1, wherein said crystallization of arabinose in step (e) is carried out in the presence of less than 10% galactose on DS as an impurity.

47. A process as claimed in claim 46, wherein said crystallization of arabinose is carried out in the presence of less than 5% galactose on DS as an impurity.

48. A process as claimed in claim 47, wherein said crystallization of arabinose is carried out in the presence of less than 2% galactose as an impurity.

49. A process as claimed in claim 1, wherein said crystallization of arabinose in step (e) comprises a single-stage crystallization.

50. A process as claimed in claim 1, wherein said crystallization of arabinose in step (e) further comprises washing the crystals obtained from the crystallization.

51. A process as claimed in claim 1, wherein said crystallization of arabinose in step (e) provides a crystalline arabinose product having a purity of more than 60% on DS.

52. A process as claimed in claim 51, wherein the purity of the arabinose product is more than 70% on DS.

53. A process as claimed in claim 52, wherein said crystallization provides crystalline arabinose having a purity of more than 90% on DS.

54. A process as claimed in claim 53, wherein the purity of the crystalline arabinose is more than 98% on DS.

55. A process as claimed in claim 54, wherein the purity of the crystalline arabinose is more than 99% on DS.

56. A process as claimed in claim 55, wherein the purity of crystalline arabinose is more than 99.5% on DS.

57. A process as claimed in claim 1, wherein the arabinose yield in the crystallization in step (e) is more than 40%.

58. A process as claimed in claim 57, wherein the arabinose yield is more than 60%.

59. A process as claimed in claim 58, wherein the arabinose yield is more than 80%.

60. A process as claimed in claim 1, wherein the crystalline arabinose obtained in step (e) has a galactose content of less than 0.5% on DS.

61. A process as claimed in claim 60, wherein the galactose content is less than 0.2% on DS.

62. A process for the crystallization of arabinose from a biomass-derived solution, wherein said crystallization comprises a single-stage boiling

crystallization in an aqueous solution from a biomass-derived solution having an arabinose purity of more than 70% on DS.

63. A process as claimed in claim 62, wherein said crystallization is carried out in the presence of less than 10% galactose on DS as an impurity.

64. A process as claimed in claim 63, wherein said crystallization is carried out in the presence of less than 5% galactose on DS as an impurity.

65. A process as claimed in claim 64, wherein said crystallization is carried out in the presence of less than 2% galactose on DS as an impurity.

66. A process as claimed in claim 62, wherein said crystallization further comprises washing of the arabinose crystals.

67. A process as claimed in claim 66, wherein said crystallization of arabinose provides crystalline arabinose having a purity of more than 98% on DS.

68. A process as claimed in claim 67, wherein the purity of crystalline arabinose is more than 99% on DS.

69. A process as claimed in claim 68, wherein the purity of crystalline arabinose is more than 99.5% on DS.

70. A process as claimed in claim 1 or 62, wherein the process comprises a further step of subjecting crystallized arabinose or said fraction enriched in arabinose to epimerization to convert arabinose to ribose.

71. A process as claimed in claim 1 or 62, wherein said arabinose is L-arabinose.

72. Crystalline L-arabinose based on vegetable fiber , which has a melting point higher than 164 °C determined by DSC with a heating rate of 10 °C/min, a melting point higher than 158 °C determined by the European Pharmacopeia method and a purity of more than 99.5 % on DS.

73. Crystalline L-arabinose as claimed in claim 72, which has a melting point higher than 165 °C determined by DSC with a heating rate of 10 °C/min.

74. Crystalline L-arabinose as claimed in claim 72, which contains galactose in an amount of less than 0.5% on DS.

75. Crystalline L-arabinose as claimed in claim 73, which contains galactose in an amount of less than 0.2% on DS.

76. Crystalline L-arabinose as claimed in claim 72, which is obtainable by boiling crystallization of arabinose.

77. Crystalline L-arabinose as claimed in claim 76, which is obtainable by combined boiling and cooling crystallization of arabinose.

78. Use of the crystalline L-arabinose of any one of claims 72 to 77 in pharmaceuticals and foodstuffs.

79. Use as claimed in claim 78, wherein the foodstuffs are selected from diet foodstuffs and diabetic foodstuffs.